# SCIENCE

NEW SERIES
VOL. LI, No. 1312

FRIDAY, FEBRUARY 20, 1920

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $6.00

# SCIENCE

FRIDAY, FEBRUARY 20, 1920

CONTENTS



MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

## THE FUNCTIONS AND IDEALS OF A NATIONAL GEOLOGICAL SURVEY[1]

*Introduction.*—During the period of unrest and uncertainty through which we are still painfully groping, the many distracting calls upon my time and thoughts have made performance of the duty to prepare a presidential address particularly difficult. In view of these circumstances I may perhaps hope for some indulgence on your part if my effort shows some lack of thoroughness in its preparation and falls somewhat short of the high standard set by some of my distinguished predecessors. The subject of a presidential address to the academy should, I think, be of wider interest and more general character than would ordinarily be an account of work in the speaker's particular branch of science, and this condition I have attempted to fulfill. Although what follows will deal especially with national geological surveys much of it will apply in principle to any scientific bureau conducted as a government organization.

*Reasons for the Existence of a National Geological Survey.*—In the beginning it may be well to review briefly the reasons for the existence of a national geological survey. Why should the government undertake work in geology while investigations in other sciences are in general left to private initiation and enterprise? The reasons that may be adduced will differ with the point of view. The geologist will suggest that whereas some sciences, such as chemistry, physics or astronomy may be pursued with success with stationary and permanent equipment at any one of a number of localities, geology is regional in its scope and is primarily a field science as contrasted with a laboratory science. Geology, it is true, must avail itself of laboratory re-

[1] Address delivered as retiring president of the Washington Academy of Sciences on January 13, 1920.

sources and methods, but the geologist can not have the greater part of his material brought to him; he must himself seek it afield. Thus it comes that comprehensive geologic problems require for their solution the equipment of more or less expensive expeditions or travel over large areas. Such projects as a rule can not be undertaken by individual geologists or by local organizations. The preparation of a geologic map of a whole country, with its explanatory text, generally recognized as essential fundamental work, is an undertaking that requires consistent effort by a central organization extending over a period of years. Such a map is not likely to result from the patching together of the results of uncoordinated local effort. From a broadly utilitarian point of view, the intelligent layman as well as the geologist must recognize that the development of a country's natural resources in such a manner as to secure their maximum use for the greatest number of its citizens necessarily depends upon reliable information concerning the character, location and extent of these resources and that this information should be available before they are exploited, by those who have eyes only for their own immediate profit, or before they pass entirely into private control or are exhausted. Such information can best be obtained and published by an impartial national organization responsible for its results to the people as a whole. Such a layman will recognize also that knowledge of the mineral resources of a country must rest upon a geological foundation. As Professor J. C. Branner has recently said in his "Outlines of the Geology of Brazil":

After a life spent chiefly in active geologic work and in the direction of such work, I should be remiss in my duty to Brazil if I did not use this occasion to urge on Brazilian statesmen the serious necessity for the active encouragement and support of scientific geologic work on the part of the national and state governments. Knowledge must precede the application of knowledge in geology as well as in other matters; and unless the development of the country's mineral resources be based on and proceed from a scientific knowledge of its geology, there must inevitably be waste of effort, loss of money, and the delay of national progress inseparable from haphazard methods.[2]

Finally, the citizen of narrower vision will regard as sufficient justification for a national geological survey the fact that he himself can turn to it for information and assistance in the development of particular mineral deposits, to his own material advantage.

As a matter of fact, most of the progressive countries of the world maintain geological surveys so that the desirability of such an organization appears to have been generally recognized, whatever may have been the particular reason or reasons that set in motion the machinery of organization in each country.

Recognizing the fact that most of the principal countries have established geological surveys and granting that there are good reasons for considering the maintenance of such an organization as a proper governmental function, we may next inquire: What should be the ideals and duties of such a geological survey? How may these ideals be realized and these duties performed?

*General Legal Functions.*—The organic act of the United States Geological Survey specifies indirectly and in general terms the field that the organization should occupy. It states, with reference to the director:

This officer shall have the direction of the Geological Survey and the classification of the public lands and examination of the geological structure, mineral resources and products of the national domain.

Doubtless the laws or decrees under which other national geological surveys have been established also prescribe to some extent their duties. Such legal authorization, however, is a rule so general as to leave room for considerable latitude in its interpretation. I propose first to discuss the functions of a national geologic survey without reference to legal prescription or definition and afterwards to consider the extent to which some

[2] Branner, J. C., "Outlines of the Geology of Brazil," Geol. Soc. America, *Bull.*, Vol. 30, p. 194, 1919.

of the actual conditions interfere with the realization of these ideals.

*Usefulness in Science.*—It has been the fashion in some quarters of late to emphasize usefulness as the chief criterion by which to judge the value of scientific research under government auspices. It has been intimated that this or that scientific bureau of the government must do "useful" work if it is to justify its existence and its expenditure of public funds. The statement is usually made with an air of finality, as if a troublesome question had been once for all disposed of and the path of the future made plain. As a matter of fact, however, when it is said that science must be useful in order to receive government support we have really made very little advance. Probably the most idealistic scientific man will admit that ultimate usefulness is the justification for scientific research although that end may not enter into his thoughts when he undertakes any particular investigation with the hope of increasing human knowledge. Men will differ very widely however as to what is meant by usefulness in science. It is well known to all scientific men, although not yet as widely recognized by others as it should be, that the utility of research is not generally predictable. For example, the investigations on electricity for hundreds of years preceding the middle of the nineteenth century had, so far as could be seen, no practical bearing. The experiments of Volta, of Galvani, and even those of our own Franklin, outside of his invention of the lightning rod, were not conducted with any thought of utility and were probably looked upon by the people of the time as diversions of the learned, not likely to have much effect upon human life and progress. How erroneous such a view was it is unnecessary to point out to a generation accustomed to daily use of the trolley car, telegraph, telephone and electric lights. Not only is the utility of science not always predictable but it is of very different kinds. That astronomy has certain practical applications in navigation and geodesy is well known; but important as these applications are they seem insignificant in comparison with the debt that we owe to this science for enlarging our intellectual horizon. This, too, is usefulness which I venture to think is of a truer and higher sort than much that passes current for utility. The classic researches of Pasteur on the tartaric acids, on fermentation, on the anthrax bacillus, on the silkworm disease and on rabies, were so-called applied science of the very highest type, indistinguishable in the spirit and method of their pursuit from investigations in pure science. They were not merely the application of knowledge to industry but were extraordinarily fruitful scientific investigations undertaken to solve particular industrial and humanitarian problems. They are especially interesting in the present connection as probably the most conspicuous example in the history of research of the merging of pure and applied science. Pasteur was doubly fortunate in that he not only enormously enlarged human knowledge but was able to see, at least in part, the practical application of his discoveries to the benefit of humanity. The value of his results measurable in dollars is enormous, yet this is not their only value. Professor Arthur Schuster, in a recent address, remarks:

> The researches of Pasteur, Lister and their followers, are triumphs of science applied directly to the benefit of mankind; but I fancy that their hold on our imagination is mainly due to the new vista opened out on the nature of disease, the marvelous workings of the lower forms of life, and the almost human attributes of blood corpuscles, which have been disclosed.
>
> The effect on a community is only the summation of the effect on individuals, and if we judge by individuals there can be little doubt that, except under the stress of abnormal circumstances, pure knowledge has as great a hold upon the public mind as the story of its applications.

Quite independently of any recognized usefulness, investigations that yield results that are of *interest* to the public are willingly supported by the people and this fact is significant in connection with what I shall have to say later on the function of education. As illustrations of this truth may be cited our government Bureau of Ethnology and our

large public museums. Probably few who read the admirable government reports on the aboriginal antiquities of our country and on the arts and customs of the Indian tribes could point out any particular usefulness in these studies but they have to do with human life and their popular appeal is undeniable. The average visitor to a museum probably has little conception of what to a scientific man is the real purpose of such an institution. He gazes with interest at the contents of the display cases without realizing that by far the greater part of the material upon which the scientific staff is working or upon which investigators will work in future, is hidden away in drawers and packing cases. The principal recognizable result so far as he is concerned is that he is interested in what he sees and feels that he is being pleasantly instructed.

In other words, it is as important for man to have his imagination quickened as to have his bodily needs supplied, and in ministering to either requirement science is entitled to be called useful or valuable.

It may be remarked in passing that Pasteur's work had this in common with pure science, or science pursued with the single aim of adding to human knowledge, in that Pasteur himself could not foresee all of the applications that would in future be made of his discoveries.

Enough, I think, has been said to show that the term usefulness as applied to science covers a wide range and that when employed by people of imagination and liberal culture may include much more than when used by those whose only standard of value is the unstable dollar.

*Functions under an ideal Autocracy.*—If government were in the hands of a wise and benevolent autocracy a national geological survey would be so conducted as to be useful to the people whose taxes go towards its support; but it would probably be useful in the broader sense that I have outlined. It would give the people not perhaps what they think they want but what, in the wisdom of their government, seems best for them. I believe that a survey so directed would aim to encourage and promote the study of geology by undertaking those general problems and regional investigations that would be likely to remain untouched if left to private enterprise. It would lay the foundation for the most economic and efficient development of the natural resources of the country by ascertaining and making known the location, character and extent of the national mineral resources. As an aid to the intelligent utilization of these resources, and to the discovery of deposits additional to those already known, it would properly occupy itself with problems concerning the origin and mode of formation of mineral deposits. Last, but not least, it would accept the responsibility, not only for making known the material resources of the country but for contributing to the moral and intellectual life of the nation and of the world by seeing to it that the country's resources in opportunities for progress in the science of geology are fully utilized. I may illustrate my meaning by examples taken from the publications of the U. S. Geological Survey. In my opinion such works as Dutton's Tertiary History of the Grand Canyon, Gilbert's Lake Bonneville, and the investigations of Marsh, Cope, and their successors, on the wonderful series of reptile, bird and mammal remains found in the Cretaceous and Tertiary strata of the west are fully as adequate and appropriate a return for the expenditure of public funds as a report describing the occurrence of a coal bed and giving the quantity of coal available in a given field. Many years ago when the United States Geological Survey was under heavy fire in Congress one member of that body in some unexplained way learned that Professor Marsh had discovered and had described in a government publication a wonderful fossil bird with teeth—a great diver up to 6 feet in length. He held this up to ridicule as a glaring example of the waste of public funds in useless scientific work, quite unaware of the light that this and similar discoveries threw upon the interesting history of the development of birds from reptiles and upon

evolution, or of the intellectual value of such a contribution to knowledge. The representative of a people educated in the value of geologic science would, by such an exhibition of ignorance, discredit himself in the eyes of his constituents.

*Functions in a Democracy.*—Our government, however, is not an all-wise benevolent autocracy but is democratic in plan and intent and suffers from certain well-known disadvantages from which no democracy has yet been free. The wishes of the politically active majority control and these wishes may or may not coincide with those of the wisest and most enlightened of the citizens. The funds for government work in science must be granted by Congress and the vote of each congressman is determined by the real or supposed desires of his constituents. A national scientific bureau, if it is to survive, must have popular support, and to obtain and hold such support it must do at least some work that the majority of the people can understand or can recognize as being worth the doing. Here evidently compromise with scientific ideals is necessary. Something must be sacrificed in order that something can be done. Such concessions and compromises are inseparable from democratic government and the scientific man of high ideals who is unable to recognize this fact will inevitably fail as a director of the scientific work of a government bureau. Such a man is likely to insist that no concessions are necessary and that the public will support science that is not interesting to it or from which it can see no immediate resulting material benefit. One very eminent geologist with whom I was once conversing held this view. He said that he had always found that he could go before a legislative body and secure appropriations for scientific research by being absolutely frank and making no attempt to show that the results of the work would be what the average man would term "useful" within the immediate future. His confidence was possibly well grounded, but I am inclined to think that the success gained by him was rather a tribute to his earnest eloquence and winning personality than a proof that the people are yet ready to contribute their taxes to the support of investigations that, so far as they can see, are neither useful nor interesting.

*Character of Compromises.*—Lest it be supposed that I am advocating the surrender of the high ideals of science to the political business of vote-getting I hasten to point out that surrender and compromise are not synonymous and may be very far apart. Some compromise there must be, but in my opinion the most delicate and critical problem in the direction of a national scientific bureau is to determine the nature and extent of this compromise so as to obtain the largest and steadiest support for real research with the least sacrifice. Complete surrender to popularity may mean large initial support, but is sure to be followed by deterioration in the spirit of the organization and in the quality of its work, by loss of scientific prestige, and by final bankruptcy even in that popular favor which had been so sedulously cultivated.

The extent to which concessions must be made will depend largely of course on the general level of intelligence of the people and upon the degree to which the less intelligent are influenced through the press and other channels by those who are able to appreciate the value of science. The more enlightened the people the more general and permanent will be their support of science.

*Importance of Popular Education in Geology.*—This leads us to the consideration of what I believe to be one of the most important of the functions of a government scientific bureau, namely, education. Of all forms of concession, if indeed it is really a concession, this is the least objectionable and most fruitful. Its results are constructive and cumulative. It is not, like other concessions to popularity, corrosive of the scientific spirit of an organization and in so far as it calls for clear thinking and attractive presentation on the part of those puting it into practise as well as the ability to grasp and expound essentials, its educational effect may be subjective as well as objective. Whatever may be true of other sciences, geologists in this

country have shown little interest in popularizing their science or in encouraging its pursuit by amateurs. Such attempts as have been made have often been inept and unsuccessful and the professional geologists have looked with more or less disdain upon those of their fellows who have tried to expound their science to the people. They have felt that men with unusual ability for research should devote all of their energy to the work of enlarging the confines of knowledge rather than to dissemination and popularization of what is known to the few. There is undoubtedly much to be said for this view and when applied to certain exceptional men it is strictly correct. When, however, we think of Darwin and compare the magnitude of his achievements with the pains that he took to make his conclusions comprehensible by the multitude, we are inclined to feel that only by extraordinary ability and performance in certain directions can an investigator in natural science be altogether absolved from the duty of making himself intelligible to more than a few specialists in his own line. There are undoubtedly many scientific men, thoroughly and earnestly convinced of the importance of their researches, who would in the long run be doing more for humanity and perhaps for themselves if they would spare some time to tell us as clearly and attractively as possible what it is that they are doing. While I believe this to be true of scientific men in general, it is particularly true of those who are officially servants of a democracy. A democratic government might almost be characterized as a government by compromise, and this is one of the major compromises that confronts scientific men in the service of such a government. The conclusion that a very important function of a national geological survey is the education of the people in geology and the increasing of popular interest in that science, appears to be unavoidable, yet it is surprising how little this function has been recognized and exercised. The results of such education are cumulative and a direct and permanent gain to science whereas, on the other hand, the consequences of prostituting the opportunities for scientific work to satisfy this and that popular demand for so-called practical results in any problem that happens to be momentarily in the public eye, is a kind of charlatanry that is utterly demoralizing to those who practise it and that must ultimately bring even popular discredit on science. A bureau that follows such a policy can neither hold within it nor attract to its service men animated by the true spirit of investigation.

*Methods of Education.*—It is not practicable in the present address to discuss in detail the many possibilities of educational work in geology. Only a few general suggestions can be offered.

In the first place the importance of education by a national geological survey should be frankly recognized and the idea that it is beneath the dignity of a geologist to participate in this function should be discountenanced. A geological survey should include on its staff one or more men of high ability who are especially gifted in interesting the public in the purposes, methods and results of geologic work—men of imagination who can see the romance of science; men of broad sympathy who know the hearts and minds of their countrymen from the Atlantic to the Pacific; men imbued with the truthful spirit of science; and finally, men skilled in the art of illuminating the cold impersonal results of science with a warm glow of human interest.

It should be the duty of these men to see that so far as possible all of the results of geologic work are interpreted to the people so that every citizen can benefit to the limit of his individual capacity. Magazines, the daily papers, moving pictures, and all possible means of publication should be utilized. There should be close contact with educators and special pains taken to prepare material for use in schools and colleges. Carefully planned courses at university summer schools and elsewhere might be given by members of the educational or publicity staff, or by certain selected geologists from the field staff.

Geologists in preparing papers and reports should consider with particular care the ques-

tion "Who may be reached by this?" Some scientific results can not be popularized and these may be written in the concise accurate language of science. Others, however, may by taking sufficient care and trouble, be made interesting to more than a small circle of scientific colleagues. Every effort should be made to enlarge this circle by simple and attractive presentation. In some cases I am inclined to think that a geologist might issue separately or as a part of his complete report, an abstract or résumé in which all effort is concentrated on an endeavor to be interesting and clear to as many people as possible. If this were done, I am sure that the writer would be in a position to appraise more truly the value of his complete report and might proceed to rewrite some portions of it and to omit others, without loss to science and at a saving in paper and printing.

*Relations with Universities.*—In connection with the subject of education attention may be called to the fundamental importance of establishing and maintaining close and cordial relationship between a government scientific bureau and the universities. The advantages of such a relationship are so many that it is difficult to enumerate them all but it may be pointed out that any plan of popular education in science will be seriously crippled if the professional teachers, whose influence in molding the thoughts and determining the careers of the young men and women of the country is so great, are out of sympathy with the government organization that is attempting to quicken the interest of the people in a particular branch of science. Moreover, it is vital to such an organization that it should attract to its service young men of exceptional ability in science. This it is not likely to do if professors of geology feel that they must conscientiously advise their most promising graduates to avoid government service. Doubtless some teachers of geology in the universities fail to realize the necessity for some of the compromises inevitable in a government bureau, or in their impatience at some of the stupidities of bureaucratic procedure are inclined to place the blame for these where it does not belong; a few may cherish personal grievances. No class of men is without its unreasonable members and neither rectitude nor tact can prevent occasional clashes; but if a national geological survey can not command the respect and hearty support of most of the geological faculties of the universities the consequences to the progress of geology must be deplorable. Any approach to such a condition demands immediate action with less emphasis on the question "Who is to blame?" for in all probability there is some fault on both sides, than on "What can be done to restore relations of mutual regard and helpfulness?"

*The Amateur in Geology.*—In the present age of specialization we are apt to forget how much geology owes to amateurs, particularly in Britain and France. Sir Archibald Geikie in the concluding chapter of his "Founders of Geology" dwells particularly on this debt. He says:

> In the account which has been presented in this volume of the work of some of the more notable men who have created the science of geology, one or two leading facts stand out prominently before us. In the first place, even in the list of selected names which we have considered, it is remarkable how varied have been the ordinary avocations[3] of these pioneers. The majority have been men engaged in other pursuits, who have devoted their leisure to the cultivation of geological studies. Steno, Guettard, Pallas, Füchsel, and many more were physicians, either led by their medical training to interest themselves in natural history, or not seldom, even from boyhood, so fond of natural history as to choose medicine as their profession because of its affinities with that branch of science. Giraud-Soulavie and Michell were clergymen. Murchison was a retired soldier. Alexandre Brogniart was at first engaged in superintending the porcelain manufactory of Sèvres. Demarest was a hard-worked civil servant who snatched his intervals for geology from the toils of incessant official occupation. William Smith found time for his researches in the midst of all the cares and anxieties of his profession as an engineer and surveyor. Hutton, Hall, De Saussure, Von Buch, Lyell and Darwin were men of means, who scorned

[3] *Vocations* would seem to be the right word here. F. L. R.

a life of slothful ease, and dedicated themselves and their fortune to the study of the history of the earth. Playfair and Cuvier were both teachers of other branches of science, irresistibly drawn into the sphere of geological inquiry and speculation. Of the whole gallery of worthies that have passed before us, a comparatively small proportion could be classed as in the strictest sense professional geologists, such as Werner, Sedgwick and Logan. Were we to step outside of that gallery, and include the names of all who have helped to lay the foundations of the science, we should find the proportion to be still less.

From the beginning of its career, geology has owed its foundation and its advance to no select and privileged class. It has been open to all who cared to undergo the trials which its successful prosecution demands. And what it has been in the past, it remains to-day. No branch of natural knowledge lies more invitingly open to every student who, loving the fresh face of Nature, is willing to train his faculty of observation in the field, and to discipline his mind by the patient correlation of facts and the fearless dissection of theories. To such an inquirer no limit can be set. He may be enabled to rebuild parts of the temple of science, or to add new towers and pinnacles to its superstructure. But even if he should never venture into such ambitious undertakings, he will gain, in the cultivation of geological pursuits, a solace and enjoyment amid the cares of life, which will become to him a source of the purest joy.

In this country at the present time, as Mr. David White in an as yet unpublished address, has I believe pointed out, the amateur geologist, due partly to the way in which the subject is taught, is rare and few indeed are the contributions made to the science by those who follow geology as an avocation or hobby. This is unfortunate and an improvement of this condition should be one of the major objects of the educational program of a national geological survey. The science lends itself particularly to its pursuit as a recreation by men of trained intellect who must find in the open air some relief from sedentary professions. In a country still so new as ours geologic problems lie on every hand and many of these can be solved wholly or in part without elaborate apparatus or laboratory facilities. The standards for the professional geologist should be high, but there is no necessity that maintenance of such standards should be accompanied by a patronizing or supercilious attitude toward the work of the amateur. Rather, let the professional geologist cultivate sympathy, tolerance, and generosity toward all who are earnestly seeking for the truth; let him help by encouragement instead of deterring by disdain. There is no better evidence of a wide interest in geology than the existence of numerous amateur workers and it is decidedly to the advantage of the professional geologist and to the science to encourage in every way possible the efforts of such workers and to increase their number.

F. L. Ransome

(*To be concluded*)

## GEORGE MACLOSKIE

George Macloskie was born in Castledown, Ireland, in 1834. He studied at Queens' University, Ireland, receiving the degree of A.B. and A.M. Later, at the University of London, he took the degrees in course of LL.B. and LL.D. He was three times gold medalist. After he had been some years in America the University of Ireland granted him the honorary Sc.D.

He was for 13 years (1861–'74) pastor of the church of Ballygoney, Ireland. During his student life and while discharging his pastorial duties he was actively interested in the study of natural history. This interest had attracted the attention of his friend and one-time teacher, Dr. McCosh, the new President of Princeton College, who called him in to occupy the chair of natural history in the recently established John C. Green School of Science, at Princeton.

In this chair, later termed biology, with unfailing devotion he served the college and university for 31 years, retiring in 1906 as professor emeritus. During this period, in addition to his teaching and executive duties, he wrote his "Elementary Botany with Student's guide to the Examination of Plants" published by Henry Holt & Company, 1883, which for several years was used in his classes. He published also a number of papers on botanical subjects, chiefly in the *Torrey Bulletin* and entomological papers, in

*The American Naturalist* and *Psyche*, dealing mainly with the structure of the head and mouth parts of the house fly and mosquitoes, and the tracheæ of insects.

An omnivorous reader, he kept abreast of the advances of his science and at the same time retained a keen interest in mathematical, physical and linguistic studies, publishing papers dealing with the mathematical properties of lenses, and on hyperbolic functions. His self-acquired mastery of a reading knowledge of the modern languages led him to a desire for some more universal means of communication, so that he was attracted to the Esperanto movement and became one of its early American promoters.

Bred as a theologian he was nevertheless in sympathy with the then new doctrine of evolution, and throughout his life was a firm upholder of the essential harmony of science and religion. His papers on this subject were numerous.

His retirement from the active duties of a professor did not lessen his abounding zeal for work, for he then began and carried through to completion a three-volume report on the Flora of Patagonia—a labor that might tax the energies of a much younger man.

Dr. Macloskie was true and loyal to his adopted country while cherishing with pride his Scotch-Irish ancestry. He was a man of strictest probity, affectionate, enthusiastic and impulsive; he was just and sympathetic in his dealings with his students; a most devoted and unselfish collaborator in the work of his own and other departments; loyally devoted to his friends through good and evil report; a good citizen and a Christian gentleman.

In 1896 Princeton University granted him the honorary A.M. As one of her adopted sons he served her faithfully in his life and his death comes as a loss to his former pupils and colleagues.

W. M. RANKIN

## SCIENTIFIC EVENTS

### THE CALIFORNIA INSTITUTE OF TECHNOLOGY

IN view of the many developments taking place in the institution, by which it is being rapidly transformed from a college or primarily local relationships into a scientific school of national importance, the trustees of Throop College of Technology, at Pasadena, voted at their annual meeting on February tenth to change its name to the California Institute of Technology.

The developments of the recent past and those assured in the near future that have seemed to justify this action are briefly as follows:

There have been received by the institution two gifts of $200,000 each to form permanent endowments for the support of research in physics and chemistry, respectively; and in addition $800,000 has been given for general purposes, on condition that this endowment be increased by additional subscriptions to two million dollars.

Other gifts aggregating $380,000 have been received for the construction of new buildings. With the aid of these funds a building for chemical instruction and research, named after the donors the Gates Chemical Laboratory, has already been completed and is occupied by the chemistry department, which includes five professors and assistant professors, two instructors, and six teaching fellows. A laboratory for aeronautical research has also been built, and investigations on airplane propellers are in progress. During the latter part of the war a laboratory for submarine detection was erected and the researches in that field are still in progress, with reference to both commercial uses and future military developments. This work will next year be transferred to the new physics building; and the war laboratory will be equipped for advanced instruction and research in applied chemistry and chemical engineering. A building for instruction and research in physics is now being planned, and is to be erected during the year. In recognition of the donation which made it possible, it will be known as the Norman Bridge Physical Laboratory. In addition, a building to serve as an auditorium and music hall, both for the Institute and for the Pasadena Music and Art Association is to be built at once upon the campus.

An impressive architectural plan for the whole campus has been prepared by the distinguished New York architect, Mr. Bertram G. Goodhue, and all the new construction is being carried out in accordance with this plan.

There have recently become associated with the faculty of the institute a number of well known investigators. Dr. Arthur A. Noyes has resigned his position at the Massachusetts Institute of Technology to become director of chemical research at the California Institute. Dr. Robert A. Millikan, of the University of Chicago, has arranged to spend one term of each year at the institute, and will have general supervision of the research and instruction in physics. Professor Albert A. Michelson, of the University of Chicago, will also spend much of his time there for the purpose of carrying on researches on the fundamental problem of earth tides, for which the necessary equipment is now being installed. Dr. Harry Bateman, formerly of Cambridge University and Johns Hopkins University, had previously joined the faculty as professor of aeronautical research and mathematical physics.

In the development of the institute special emphasis is being placed upon research, not only because every institution of higher education should contribute to the advancement of science, but also and particularly because a prominent feature of the work of instruction is to be the training of engineers of the research or creative type. While the institute will continue to offer four-year undergraduate courses which fit its students directly for the positions of operating and constructing engineers, two new courses of instruction, to be known as the courses in physics and engineering and in chemistry and engineering, will soon be announced by the faculty, in which special stress will be laid on an unusually thorough grounding in the three fundamental sciences of physics, chemistry and mathematics; and in the last two years of which much time will be assigned to research in physics and chemistry; the time required for these purposes being secured by omitting some of the more technical engineering subjects included in the other engineering courses.

The faculty has also been strengthened on the side of humanistic studies by renewal of the arrangement with Alfred Noyes, the English poet, which was in effect before the war, under which he will during the next year give courses of lectures on English literature; and by the appointment of Paul Perigord as professor of economics.

### THE ANNUAL MEETING OF THE BOARD OF TRUSTEES OF THE AMERICAN MUSEUM OF NATURAL HISTORY

Announcement of the nature and scope of the activities of the American Museum of Natural History during the past year and of a prospectus for the coming fifty years was made on February 2 by President Henry Fairfield Osborn, at the annual meeting of the board of trustees, held at the home of Arthur Curtiss James, 39 East 69th Street, who acted at host.

Due to its urgency, the matter of maintenance and building funds was given prominence. It was reported that the Museum is now facing the most critical time of its history.

While progress is being made in many directions, President Osborn said, it is not symmetrical, and in order to secure a harmonious educational treatment and to truthfully arrange our present collections, the museum needs double the space which it now occupies. It is fifteen years since the building has been enlarged, and during this time the collections have nearly doubled. President Osborn ascribes this marking time of progress not to lack of cooperation on the part of the board of estimate and apportionment of the city, which has recently manifested its confidence in the institution by increasing the annual maintenance fund fifty per cent.; nor to lack of interest on the part of the trustees, who have been signally generous, contributing the sum of over $100,000 in 1919 alone to meet deficiencies in the budget; nor to lack of friendliness on the part of the Board of Education, which has also

given its cooperation. He gave three very sufficient reasons in the following: the unprecedented growth of the collections; the actual shortage of funds in the city treasury; and the interruption by the war of building extension through personal subscription of the trustees which was planned in 1913.

He went on to point out that the whole educational system of New York city and state has suffered from the same causes; that conditions have arisen where we are compelled to take a very large and constructive view of the future. The need of the hour as felt in every one's mind is Americanization, which can be accomplished only through the thorough training of our youth according to American ideals. The free schools, colleges, libraries, museums, scientifically arranged parks and aquaria, free lectures and free concerts designed for instruction and inspiration form the structure on which Americanization rests. In this structure, the American Museum has won a vital place. In its school educational work, the museum holds a strong position. In the last five years it has reached 5,650,595 children directly and indirectly through its lecture system and traveling museums; it has expended $89,126.08 of its own funds directly on public education, in addition to the $1,538,057 expended on explorations, collections and researches, the results of which ultimately find their way into the school mind. The scope and efficiency of its public educational work is such as to have called forth the enthusiastic admiration of the British Educational Mission on its recent visit, and to be taken as a model for educational development in Great Britain.

With all this obvious advance, the museum has in certain ways come to a full stop in its educational activities. This is particularly true of exhibition work. In hall after hall the arrangement is less truthful and more misleading than it was twenty years ago, for the collections are jumbled together out of their natural order, giving, in cases entirely erroneous impressions. It is therefore, not a civic luxury, but a *paramount educational necessity* which demands the enlargement of the museum buildings and the provision of the necessary equipment. The most important thing for the museum to-day is immediate building space and equipment. And the next most important thing is the immediate increase of its general endowment by not less than $2,000,000 in addition to the munificent bequest of Mrs. Russell Sage.

In exploration and field work but little more activity was possible than in 1918. Roy C. Andrews continued his work in northern China and Mongolia, and has been eminently successful in securing valuable series of goral, serow and mountain sheep. Paul D. Ruthling and Karl P. Schmidt have collected reptiles and amphibians in Mexico and Porto Rico. Henry E. Crampton has continued his work in the Society Islands; George K Cherrie and Harry Watkins have secured collections of small mammals and birds in Venezuela and Peru; and Herbert J. Spinden has made archeological collections in Peru, Colombia, Dutch Guiana and Central America. In the United States, valuable and unique archeological and ethnological material was secured in Arizona and New Mexico by Leslie Speir and Earl H. Morris, and a collection of Miocene fossils including a slab containing a number of skeletons of the two-horned Rhinoceros *Diceratherium* were obtained by Albert Thomas in Nebraska.

During the year over 600 accessions to the collections were recorded. Some of the more important gifts were: the painting of the eclipse of the sun in 1918 by H. R. Sutler, presented by Edward D. Adams; a Chinese painting on silk of the last dynastic period, 1761, presented by Ogden Mills; a lacquered dog-house from a Chinese imperial palace, from Miss Theodora Wilbour; skin of an albino deer, from Archibald Harrison; a series of bronze objects from Sumatra from Arthur S. Walcott; and a collection of ethnological specimens from Zuni, from Mrs. Elsie Clews Parsons.

Nearly 900,000 people visited the museum in 1919, exceeding by 175,000 the attendance of 1918. The net gain in membership was 615, the total membership now being 5,183.

Childa Frick was elected a trustee.

Those present at the annual meeting were: Thomas DeWitt Cuyler, Cleveland H. Dodge, Walter Douglas, Madison Grant, William Averell Harriman; Archer M. Huntington, Adrian Iselin, Arthur Curtis James, J. P. Morgan, Henry Fairfield Osborn, Percy R. Pyne, Theodore Roosevelt, John B. Trevor and Francis D. Gallatin.

### NEW YORK MEETING OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

THE American Institute of Mining and Metallurgical Engineers under the presidency of Mr. Hoover, met in New York City this week. Three sessions of the annual meeting were devoted to the subject of coal. In the first of these facts were brought out on some of the questions around which controversies raged during the recent strike, including: Why is production intermittent? How and when do the irregularities occur? How many days a year do the men actually work? What are the actual wages received by men during each season and in what way can the wage basis be changed? How and where can coal be stored at the mine, at industrial plants or elsewhere?

The fundamentals of the problem were presented in a series of papers by authorities. Van H. Manning, director of the U. S. Bureau of Mines, outlined conditions in a paper on "The problems of the coal industry." George Otis Smith, director, U. S. Geological Survey, presented a statistical analysis of the rate of output over a period of years, showing the relative effect of shortage of transportation and of labor and lack of market and other factors in the production of coal. H. H. Stoek, of the University of Illinois, discussed the storage of bituminous coal at the point of production, at centers of distribution and by the consumer. S. L. Yerkes discussed transportation as a factor in irregularity of coal-mine operation.

The business side was presented by Eugene McAuliffe, president of the Union Colliery Company, in a paper on stabilizing the market. Edwin Ludlow, of the Lehigh Coal and Navigation Co., discussed conservation as applied to mining methods, by-products and consumption.

Unpaid taxes on mines amounting to $200,000,000 were involved in a discussion at an open forum held on the subject of mine taxation. The views both of the government and the mine owners were presented, the discussion being led by Ralph Arnold, valuation expert of the Petroleum Division of the Internal Revenue Department; J. R. Finlay, who evaluated the mines of the state of Michigan; J. Parke Channing, of New York, and R. C. Allen, vice-president of the Lake Superior Ore Association.

In the evening of February 17 more than one thousand delegates and their friends attended a banquet at the Waldorf-Astoria at which Lawrence Addicks was toastmaster. President Herbert Hoover, retiring President Horace V. Winchell and Professor James F. Kemp, of Columbia University, were the speakers.

Besides Mr. Hoover as president, the following officers were elected: Frederick Laist, Anaconda, Mont., and Seeley W. Mudd, Los Angeles, vice-presidents. W. R. Walker, New York; A. S. Dwight, New York; R. M. Catlin, Franklin Furnace, N. J.; G. H. Clevenger, Washington, D. C., and W. A. Carlyle, Ottawa, Canada, directors.

### RESOLUTIONS ON THE DEATH OF SIR WILLIAM OSLER

ON motion of the executive committee of the Federation of American Societies for Experimental Biology in Cincinnati December 30, 1919, the following minute was drafted:

In the death of Dr. Osler, the medical profession has suffered an immeasurable loss. Belonging to no cult, or age, or clime, but descended in direct line from Hippocrates, he was master of the art of medicine in its purest form. As a teacher, he was again master, painting with broad strokes pictures of disease never to be forgotten by the student. An investigator and an inspirer of investigation, a worthy counsellor of brother physicians, a delver in the history of medicine, and an ornament to its letters; and withal so human and of such rare personal charm as to be beloved of all who came in contact with him. Such was the man we mourn.

We grieve not only at loss of leader and friend,

but also that death overtook him in the very shadow of the great conflict which brought him so great personal loss and sorrow and robbed him of the mellow years which were so fully his due.

(Singned)
C. H. BUNTING,
HENRY A. CHRISTIAN,
A. S. LOEVENHART,
*Committee*

## SCIENTIFIC NOTES AND NEWS

DR. LUDVIG HEKTOEN, of the John McCormick Institute for Infectious Diseases, Chicago, has been elected honorary member of the Pathological Society of Philadelphia.

DR. E. V. MCCOLLUM, professor of chemical hygiene, school of hygiene and public health, Johns Hopkins University, has been made corresponding member of the Academie Royale de Médecine de Belgique.

DR. HERBERT E. GREGORY, Silliman professor of geology, Yale University, sailed on February 17, to resume his duties as acting director of the Bishop Museum at Honolulu, Hawaii. Professor Gregory will return to New Haven in September.

DR. WILLIAM T. SEDGWICK, senior professor of the Institute of Technology and head of the department of biology and public health, will be the first exchange professor with the British universities of Cambridge and Leeds. Dr. Sedgwick will leave for England early in April, and expects to spend the summer in Europe, returning to Boston in September.

DR. ROBERT W. HEGNER, associate professor of protozoology in charge of the department of medical zoology in the School of Hygiene and Public Health, has been appointed a delegate from The Johns Hopkins University to the Congress of the Royal Institute of Public Health which meets in Brussels from May 20 to May 24, 1920. Dr. Hegner will read a paper at the Congress on "The relation of medical zoology to public health problems." He expects to spend the months of June, July and August in study at the Liverpool and London Schools of Tropical Medicine and in visiting other institutions in Europe and Africa where medical zoology is being taught or investigated.

ERNEST F. BURCHARD, geologist in charge of the iron and steel section, U. S. Geological Survey, has been granted a ten months' absence and will make geologic investigations in the Philippines.

DR. M. W. LYON, JR., formerly professor of pathology and bacteriology, George Washington University, and at one time connected with the Division of Mammals, U. S. National Museum, and captain in the Medical Corps during the war, has left Washington to take charge of pathological work at South Bend, Indiana.

WE learn from the *Journal* of the American Medical Association that, following the usual custom, Professor Laveran, formerly vice-president, has assumed the duties of president of the Paris Academy of Medicine for the year 1920. Dr. L. G. Richelot, hospital surgeon and professor of medicine in the University of Paris, was chosen vice-president for the year 1920, and Dr. Arcard, also of the University of Paris, was elected secretary for the year. Dr. F. Lejars, professor of clinical surgery, has been elected president of the Surgical Society for the year 1920.

IT is announced in *Nature* that Professor R. T. Leiper, reader in helminthology in the University of London, has been awarded the Straits Settlement gold medal by the senate of the University of Glasgow. The medal was founded some years ago by Scottish medical practitioners in the Malay States, and is given periodically to a graduate in medicine of the Scottish universities for a thesis on a subject of tropical medicine.

DR. CARLOS E. PORTER, editor of the *Revista Chilena de Historia Natural*, of Santiago, Chile, is about to publish a work, upon which he has been engaged for fifteen years, on the museums and naturalists of Latin America. The work will comprise three volumes abundantly illustrated. Dr. Porter is enabled to publish this work through the financial support of Dr. Chistobal M. Hicken, professor of botany and geology in the faculty of natural

science of Buenos Aires, known through his explorations of Patagonia.

Sir Arthur Newsholme, lecturer on public health administration, school of hygiene and public health, Johns Hopkins University, delivered the annual Frederick A. Packard Lecture of the Philadelphia Pediatric Society in Thompson Hall, College of Physicians, February 10, on "Neo-Natal Infant Mortality."

At the meeting of the Institute of Medicine of Chicago, January 30, at the City Club, Dr. Victor C. Vaughan, of the University of Michigan, Ann Arbor, presented a paper on "Remarks on the Chemistry of the Protein Molecule in Relation to Infection," and Dr. Karl K. Koessler spoke on "The Relations of Proteinogenous Amins to Medicine."

Among the speakers at "Farmers' Week" at the Michigan Agricultural College from February 2 to 6 inclusive, were Dr. E. V. McCollum, of the Johns Hopkins University; Dr. F. J. Alway, of the University of Minnesota, and Dean Alfred Vivian, of the Ohio State University. Being members of the American Chemical Society they were the guests of honor at a luncheon given by the local section of that society on February 5, at which about forty members were present.

As a permanent memorial of Dr. Christian R. Holmes, his friends have inaugurated plans to raise a fund of $1,000,000 for medical research, the endowment to be known as the Christian R. Holmes Medical Research Fund. The Carnegie Corporation has made a gift of $250,000 to the medical college of the University of Cincinnati, as a tribute to Dr. Holmes's services and to endow a chair in his memory.

Robert Hollister Chapman, for many years topographical engineer of the U. S. Geological Survey, died of pneumonia in New York where he was attending a meeting of the American Alpine Club, of which he was secretary. After the United States entered the war Mr. Chapman became a major in the Engineers' Reserve Corps. He was born in New Haven in 1868.

Dr. Elmer Ernst Southard, Bullard professor of neuro-pathology at the Harvard Medical School, died from pneumonia on February 8, aged forty-four years.

Sir Thomas R. Fraser, F.R.S., emeritus professor of materia medica, University of Edinburgh, died on January 4, at seventy-eight years of age.

Dr. Edwin A. Strong, emeritus professor of physics at the Michigan State Normal College, died on February 4 at the age of eighty-six years. He devoted nearly sixty years of his life to the promotion of education and science in Michigan in long terms of service at Grand Rapids and Ypsilanti.

A regular meeting of the American Physical Society will be held in Fayerweather Hall, Columbia University, New York, on Saturday, February 28. If the length of the program requires it, there will also be sessions on Friday, February 27. The next following meeting of the society will be held in Washington on April 23 and 24.

Mr. James Simpson, vice-president of Marshall Field & Co., Chicago, will present the Field Museum of Natural History with a large assembly hall or theater. The seating capacity will be 925, exclusive of lobbies extending around three sides of the theater. The theater is to be in the west wing of the main building of the museum.

A Pasteur Institute has been inaugurated at Managua, Nicaragua, presented to that country by the President of Mexico. The institute has therefore been named Instituto Antirábico Carranza.

Under the auspices of the Pan-Pacific Union, arrangements are being made for a scientific conference to be held in Honolulu, Hawaii, August, 1920. The purpose of the conference is to outline some of the fundamental scientific problems of the Pacific Ocean region and to formulate methods for their solution. The plan involves the cooperation of representative scientists and institutions from the countries whose interests lie within or about the Pacific with the hope that a program of research may be developed which will eliminate duplication

of effort and of funds. The program of the conference is in the hands of the Committee on Pacific Exploration of the National Research Council.

THE U. S. Bureau of Chemistry at Washington announces that the work on photosensitizing dyes begun during the war for the Bureau of Aircraft Production has met with such success as to make possible the preparation in the United States of dyes of all the recognized types: pinaverdol (including Orthochrome T), cyanine, pinacyanol and dicyanine; and of a new type useful for astrophotographic work. The Color Laboratory of the bureau will place its experience at the disposal of any manufacturer who wishes to prepare these important photographic aids for the American market; and pending their commercial availability is prepared to supply them to users at a price fixed by the secretary of agriculture.

## UNIVERSITY AND EDUCATIONAL NEWS

DR. EDGAR F. SMITH, provost of the University of Pennsylvania since 1911, tendered his resignation to the board of trustees on February 9. Dr. Smith became professor of chemistry in the University of Pennsylvania in 1888.

DR. JACOB GOULD SCHURMAN has resigned the presidency of Cornell University. Dr. Schurman, previously professor of philosophy, became president of Cornell University in 1892.

DR. CHARLES W. DABNEY has resigned the presidency of the University of Cincinnati, which he has held since 1904.

DR. JOHN M. T. FINNEY, Baltimore, has declined the offer made him by Harvard University and will continue his connection with the Johns Hopkins Hospital and Medical School.

DR. H. H. LANE, who has since 1905 been head of the department of zoology of the University of Oklahoma, has accepted a position for next year as head of department of zoology, of Phillips University, Enid, Oklahoma.

## DISCUSSION AND CORRESPONDENCE

### BLOOD-INHABITING PROTOZOA FOR CLASS USE

AT the present time there are several large and important groups of Protozoa that remain unknown to students of biology chiefly because they are not easy to obtain when they are needed. One of these groups that is of added interest because of the economic importance of some of its members contains the hemoflagellates, including the trypanosomes. Trypanosomes are responsible for the human disease known as sleeping sickness, that is prevalent in certain parts of Africa, and for Chagas' disease in South America. They also cause diseases in domestic animals such as surra, nagana, murrina, mal de caderas and dourine which result in great losses every year.

The first trypanosome described was found in the frog in 1843 and was given the name *Trypanosoma rotatorium*. Specimens belonging to this species occur in the frogs of this country, particularly in the "water" frogs such as the green frog, *Rana clamitans*, and the bullfrog, *Rana catesbiana*, but they are present usually in small numbers and not all frogs are infected. If it is desired to obtain for study this type species the centrifuge may be used to concentrate the specimens. Blood may be obtained from an etherized frog and mixed to prevent clotting with a solution of sodium citrate made up as follows: sodium citrate, 1½ grams; sodium chloride 1½ grams; water 250 c.c. After centrifuging for about ten minutes the trypanosomes, if present, will be found in a layer at the top of the mass of red blood cells.

A much more simple method of furnishing trypanosomes to a large class of students is to collect a few newts, *Diemyctylus viridescens*, from the water. Tobey in 1906 first described the species in these newts naming it *Trypanosoma diemyctyli*. He found them present in every specimen that he had purchased in an animal store in Boston. The writer has had a similar experience with newts collected for him in Pennsylvania. Seventy-

eight of the olive-green water form and seven of the vermillion land form were examined. Every one of the former was abundantly supplied with the parasites, but only two of the land forms were infected.

All that is necessary to obtain living specimens of the trypanosomes for study is to snip off a little piece from the end of the tail, and then squeeze out several drops of blood on each slide. A cover glass can be added directly or a ring of vaseline may first be spread around the blood so that the preparation will be sealed when the cover glass is put in place. In such a preparation the spiral movement of the organism is evident, and the flagellum and undulating membrane are easily observed in action. The nucleus and other structures are clearly revealed in dried films stained with Wright's or Leishman's stains. Obtain a drop of blood near one end of a clean slide. Place the end of another slide near the drop of blood at an angle of about 30 degrees with the shorter end of the slide. Draw this slide along until it touches the drop. When the blood has spread along the edge, push the slide fairly rapidly toward the other end. A thin even film will result covering about one half of the slide. Allow this to dry. Then place a few drops of the stain on the film and allow to remain one minute. Add double the volume of distilled water and after five minutes wash the film with distilled water, and dry in the air. Balsam and a cover glass may then be added but the stain will fade. If oil immersion objectives are available no cover glass should be used but the oil placed directly on the film, and after the examination is completed this oil may be wiped off with lens paper or washed off with xylol. The stain may be obtained in small 0.1 gram tubes. This amount is dissolved in 10 c.c. of pure methyl alcohol and is then ready for use.

R. W. Hegner

School of Hygiene and Public Health,
The Johns Hopkins University

### HORIZONTAL RAINBOWS

To the Editor of Science: With respect to Reese's account of an "unusual form of rainbow" in Science for December 12, 1919 (Vol. L., p. 542), it may be said that, in Europe, rainbows on the surfaces of ponds and lakes have been reported from time to time during the past fifty years. They have been observed, also, on several bodies of water in Japan during the past few years and the investigators of that country have given some attention to the mathematical explanation of these phenomena.

In the United States these spectral displays have been seen frequently on the surface of Lake Mendota at Madison, Wisconsin, during the past ten or twelve years. Some of these displays have been unusually brilliant and varied; double and triple primary bows together with a secondary bow have been noted at times. These phenomena have been described in the *Monthly Weather Review* for February, 1916 (Vol. 44, p. 65).

The complete bows that have appeared on the surface of Lake Mendota possessed a very different outline from the diagram shown by Reese. They were parabolic in shape instead of circular; neither did they possess an inverted segment connecting the outer extremities as in his figure.

As far as the present writer is aware, these horizontal rainbows have been reported for only two lakes in this country, namely, Lake Mendota and the lake referred to by Reese. This seems to indicate that it is not a widespread phenomenon, or else other observers have not taken the trouble to publish accounts of their observations. It would be interesting to know whether these spectral colors have been seen on any other bodies of water in this country.

Chancey Juday

Madison, Wisconsin

### CHEMISTRY APPLIED TO COMMERCE

The divorce of science and industry, which has long been a noisesome skeleton in our economic household, is fast being annulled. "During the war, American industry acquired —or had thrust upon it—a wholesome respect for American science," *Drug and Chemical*

*Markets* said in a recent editorial, and this organ of commercial chemistry might well have added that at the same time American science learned the wholesome lesson that American industry has problems and aims not altogether ignoble. It is no longer the hall-mark of the practical business man openly to hold in contempt all knowledge gained from books or laboratories. The man of science no longer believes that the application of his training and talents to practical problems is prostitution.

During the war period, the practical problems of the chemical industry were problems of production. American chemists helped solve these production problems, and, now that war conditions are passing, American chemical manufacturers naturally turn to them for help in solving the problems of distribution. This help must come finally from our colleges and universities.

It is not necessary for me to point out that chemical manufacture is a "key industry," nor to emphasize the fact that, if we are to keep the tremendous advantages we have won during the past five years in the development of the American chemical industry, a bitter trade war must be successfully waged. Soon our manufacturers will meet, both at home and abroad, the products of foreign competitors. Then the trade war will be declared in earnest, since our domestic consumption of chemicals is not sufficient to support a self-contained industry. Our Allies have all increased their chemical productivity greatly, and they appreciate, quite as well as we do, the vital importance of this industry. Germany has always had a nice comprehension of the place of chemicals in industry and in warfare, and her chemical equipment, both men and plants, is intact.

To make chemical products in competition with the world avails us nothing if we can not market them successfully in world-competition. Chemical manufacturing is the most diversified and technical of industries, and its basic conditions place a premium upon technical training; its productive branches are as complex, for the diversified products to be marketed are bought by many consumers and their uses are various and often highly technical. Men of technical, chemical training who can market our American-made chemicals are needed to-day.

Detailed, expert knowledge of the goods he handles is an important part of the salesman's equipment, for, since he can no longer sell his customers by means of cigars and jokes, he must render them a service. This service is often expert advice. Dyes must be properly applied; medicinals must be intelligently prescribed; aromatics must be skillfully combined. New markets must be developed for old chemicals and new products must be introduced. A smattering of chemical trade jargon is poor equipment for such work, and it is worth remembering that the German dye trusts took pains to send out salesmen trained in the chemistry of dyestuffs and speaking the language of the countries they visited. The haphazard supply of men who have taken more or less chemistry at college and who chance to become salesmen is in no way able to meet this kind of selling competition. Graduates in chemistry are seldom fitted by temperament or experience for this work: salesmen are not often equipped with technical training. Chemistry applied commercially to distribution is even further removed from the pure science than are industrial research and production work. The commercial instinct, however, is not to be condemned, and courses in commercial chemistry would attract undergraduates who, after a year's course, would normally drop out of the ken of the chemistry department. The training of so-called chemical engineers has brought to the study of chemistry many students anxious to become plant executives, but quite indifferent to analysis, research, or teaching. Courses in commercial chemistry would, in like manner, open up new opportunities.

The foundation of such courses would naturally be a broad one of chemistry upon which could be raised a working knowledge of analysis and of important industrial processes. The uses of chemical products in the industries—steel, textile, leather, rubber, paper,

glass, fertilizers, etc.—ought to be treated in such courses, and crude drugs, essential and fixed oils, and petroleum, are products closely allied commercially to chemicals about which the student should know something. A series of lectures on the chemical markets—how chemicals are sold, containers, insurance, fire risks, sales contracts, etc.—might well be delivered by some sales manager or broker familiar through daily, practical experience with this subject. Supplementary courses in applied economics, such as given in many of the larger universities on banking and finance, commercial law, traffic and transportation, business administration, advertising, and even actual salesmanship, might to advantage be offered to the students of commercial chemistry.

A definite and very real need for men with technical training in chemistry as applied to commerce exists and, as yet, there has been no systematic, serious effort on the part of our colleges and universities to supply this demand. Young men equipped with this training would find places in the most highly paid branch of industry open to them, and institutions giving this training would increase the scope of their chemistry departments. Moreover, to supply the American chemical industry with technically trained merchandizing experts will strengthen a "key industry," necessary to national prosperity and, in event of war, essential to national preservation.

Williams Haynes

New York City

## SCIENTIFIC BOOKS

*The Physical Chemistry of the Metals.* By Rudolph Schenck, Professor of Physical Chemistry in the Technischen Hochschule in Aachen. Translated by Reginald Scott Dean, Research Metallurgist, American Zinc, Lead and Smelting Company. New York. John Wiley and Sons, Inc. 1919. VIII + 239 pages.

It is surprising that this book published in Germany in 1908 should have escaped the eye of the translator until now. It is, however, most encouraging to the future of American industry to find the translator connected with one of the large metallurgical plants. Usually texts which deal largely with theoretical subjects are translated by college men for use in their classes and find their way into the practical field only indirectly. It is, therefore, doubly welcome to see a translation emanating from an industrial plant.

The book deals very largely with principles, but is eminently practical for the metallurgist. The chapter headings: I. Properties of Metals; II. Metallic Solutions and Alloys; III. Alloys of Metals with Carbides, Oxides and Sulphides, Iron and Steel, Mattes, Phase Rule; IV. Metallurgical Reactions, Oxidation and Reduction; V. Decomposition of Carbon Monoxide, Blast Furnace Process; VI. The Reactions of Sulphides give a good idea of the subject matter contained in the book. All of this material is essential to the well-trained metallurgist, but particularly that in the last four chapters. Each subject is treated briefly, but clearly and special emphasis is laid upon equilibrium phenomena and the factors which influence equilibrium. The reactions between carbon and oxygen and metallic oxides receive the full attention they deserve.

With the many merits which the book has it is surprising that it has some simple faults which might easily have been corrected. As examples might be mentioned the following: the omission of the eutectic lines in the diagram on page 51; the form of curves 1, 2, and 4 in diagram on p. 50; the inadequacy of the treatment of Crystal Growth on p. 20; the synonymous use of the terms martensite and austenite; the use of the term sorbitic as applied to chilled cast iron. These are, however, unimportant and it is hoped and believed that the book will be a distinct help to American metallurgists.

H. F.

## SPECIAL ARTICLES

### THE DEVELOPMENTAL ORIGIN OF THE NOTOCHORD

The notochord is so constant, fundamental and distinctive a structure in the Chordate

group that its interpretation—as is of course thoroughly known—has received great attention, and it plays a part in many of the theories of "the origin of vertebrates." Despite the great theoretical importance attaching to the origin of the chorda dorsalis or notochord, we find in the current text-books statements of its origin most conflicting—and as it seems to me unnecessarily so. Of five standard text-books of human anatomy in the English language, two give the notochord as entodermal, three as derived from the primitive streak. Of five text-books of histology, two describe the notochord as entodermal, one as ectodermal, while two make no statement; two standard comparative anatomies give the notochord as entodermal; of seven embryology texts, five state that it is of entodermal origin, although three of these qualify it as an apparent origin only, one gives the notochord as mesodermal, while one states that it may in different vertebrate groups be ectodermal, mesodermal, or entodermal. Three standard text-books of pathology state that the notochord is an endodermal structure. Most text-books of zoology will probably be found to adhere to the entodermal origin of the notochord. The preponderant statement is thus that the notochord is an entodermal structure, and since this is the origin in the latest human anatomy and in the latest vertebrate embryology, it is clear that this interpretation is not an old obsolete one held over from edition to edition.

In the attempt to reconcile the apparent differences of origin of the notochord or the different interpretations, we have two attitudes illustrated: (1) Kellicott in his "General Embryology" confessedly accepts an origin from any one of the three germ-layers when he says (p. 358): The "notochord may with equal correctness be described as entodermal, mesodermal or even ectodermal, in various forms." Kingsley, in his "Comparative Anatomy of Vertebrates," who accepts the entodermal origin says, however (p. 13, footnote): "The statement is made that in some groups the notochord arises from another germ layer than the entoderm, but these statements apparently rest on erroneous observations or interpretations. Different origins in different vertebrates would tend to show that what are called notochord are not homologous." It requires but brief review of the early development of the chick (for example) to recognize that the notochord is here developed from the primitive streak and hence not entodermal. Furthermore, the fundamental plan of the vertebrate body is so constant and the occurrence, position, extent and relations of the notochord so uniform that any suggestion that the notochord is not homologous in the different vertebrate classes must be rejected at once as without evidence. Finally, it would be improbable that such a structure as the notochord should have fundamentally different origins in different forms as Kellicott felt forced to asume.

When the facts of vertebrate development are fully examined, it becomes at once apparent that it is unnecessary to assume lack of homology, error in interpretation or real diversity in origin, but that in all vertebrates whose development has been traced—from *Amphioxus* up to man—the notochord is formed from the dorsal lip of the blastopore or (in higher forms) its equivalent the primitive streak. For the preponderance of the view that the notochord is an entodermal structure perhaps three things are mainly responsible: (*a*) the prevailing tendency to interpret development as seen in the convenient transverse plane, with (*b*) neglect of the concomitant changes in the long axis and without an appreciation of the dorsal lip of the blastopore as the center of differential growth which lays down, along with other structures, the notochord. (*c*) The preponderant work done upon the development of the lower vertebrates, particularly *Amphioxus* and the *Amphibia*, where, as followed in transection without an accompanying consideration of the growth in the longitudinal planes, it would be unhesitatingly stated that the notochord was folded off from the entoderm. But even in these forms, it would be only the first, more cephalic, portion, of the notochord that could be under any interpretation termed ento-

dermic, since as soon as the so-called "tail-bud" has formed by growth-transformation of the blastoporic lip, differential growth in that region continues to form notochord that has no association with the entoderm whatever. Cerfontaine,[1] it may be pointed out, in his classical paper on the early development of *Amphioxus*, has critically studied the development of the notochord from the dorsal blastoporic lip, and accordingly ranks it as an ectodermal structure.

It is unnecessary to take up here in detail the evidence of the formation of the notochord from the blastoporic lip. There is no reason to consider the development of the chick as exceptional among birds. In mammals, the evidence as it accumulates shows the same mode of origin (from the primitive streak), as exemplified by the recent careful description of Huber[2] for the guinea pig.

The acceptance of the origin of the notochord from the dorsal lip of the blastopore (resp. primitive streak) throughout the vertebrate group (including *Amphioxus*) leads naturally to the statement that the notochord is to be regarded as ectodermal in origin. For many years it has seemed to the writer that the conception of a germ-layer should include nore than topographical relation. It is therefore advantageous to consider the blastoporic lip, primitive streak and so-called "tail bud," undifferentiated material rather than definitive ectoderm, and having within it the "potentialities" of the several structures developed out of it. Its cells would be "totipotent" or at least "pluripotent," if we wish to use these terms. Particularly from the pathological viewpoint, in the interpretation of teratomata from the persistence of undifferentiated cells of primitive streak or tail-bud origin would this be helpful.

The notochord throughout the vertebrate class shows the marked association with the entoderm, which is of course directly responsible for the prevailing view that the notochord is an entodermal structure. While in the phylogenetic interpretation of the origin of the notochord this fact must ultimately be taken full account of, ontogenetically, the entoderm is the only one of the three germ-layers which can not be considered as the source of its cells—the one to which it may be referred. Many, as indicated above, from the fact of the superficial location of the formative centers in the blastoporic lip will regard the notochord as ectodermic. One may, as Keibel clearly does,[3] consider it unnecessary to refer the notochord to any germ-layer. However, if we must group the notochord in with one of the three fundamental germ-layers, it has seemed to the writer that the notochord must be included among the mesodermal structures, for the following reasons: (1) The mesoderm—or, to make due allowance for other possible sources of mesoderm—that portion of the mesoderm with which the notochord is associated is developed from the blastoporic lip (resp. primitive streak, tail-bud), and is similarly "handled" in development. When, as in *Amphioxus* the notochord is at first associated with the entoderm, forming temporarily part of the roof of the archenteron, the mesoderm is similarly associated. (2) It attains like the mesoderm an interior (intermediate) position. (3) It is endoskeletal in its physiologic significance. (4) The notochord in amphibia and reptilia at least gives rise to hyalin cartilage, a tissue of recognized mesodermal characteristic. This seems to be clearly shown by a number of investigators.[4] Considerations similar to the above led Triepel[5] to pronounce the notochord a mesodermal structure.

Were the pathologists to accept the notochord as a mesodermal structure rather than entodermal, it may be suggested that the close resemblance of chordomata to myxomata, myxo-chondromata and chondromata, which I

[1] Cerfontaine, P. *Arch. de Biol.*, Vol. 22, 1906.

[2] Huber, G. Karl, 1918, *Anat. Record*, Vol. 14.

[3] Keibel, Franz, 1900, *Anat. Hefte*, Vol. X.; Keibel, Fr., 1910; Keibel and Mall, Vol. I., Ch. V.

[4] Bruni, A., 1912, *Anat. Hefte*, Vol. 45. Krauss, Fr., 1909, *Arch. f. mikr. Anat.*, Vol. 73. Pusanow, I., 1913, *Anat. Anzeiger*, Vol. 44. Schauinsland, H., 1906, in Hertwig's *Handbuch d. vergel. Entw. ges.*, Vol. III., Pt. 2.

[5] Triepel, H., 1914, *Anat. Hefte*, Vol. 50.

understand so frequently makes diagnosis difficult, might have added significance.

B. F. Kingsbury

Department of Histology
and Embryology,
Cornell University

## THE CONFERENCE AT CLEVELAND ON THE HISTORY OF SCIENCE

Readers of Science may be interested in some account of what was probably both the most novel and significant conference of all those held by the various learned associations at their recent holiday meetings, namely, the conference devoted to the History of Science at the Annual Meeting of the American Historical Association in Cleveland. Of even more value than the papers read and the public discussion, although these were marked by an unusual degree of originality, interest, and enthusiasm, and were heard by an audience of very gratifying numbers, most of whom remained throughout the unusually long session, was the opportunity offered—in many instances for the first time—to those engaged in research in this promising field to become personally acquainted, and to talk over matters of common interest informally and face to face.

The chairman of the conference, George L. Burr, librarian, and Andrew D. White professor of history at Cornell University, and a former president of the American Historical Association, presided with something even more than his characteristic charm and felicity. In his opening remarks he noted the fact that while isolated papers bearing on the history of science had been presented at some previous meetings of the American Historical Association, this was the first time in the history of that organization that a conference had been especially devoted to that subject. He also emphasized the rapid strides that research in this subject had made in recent years. Of the papers which followed it will be possible to give only a very brief and, I fear, otherwise imperfect summary here; it is to be hoped that they may be published in full at an early date.

T. Wingate Todd, professor of anatomy in the medical school of Western Reserve University, in an illustrated address on Egyptian medicine showed the predominance of ritual and superstition in that field and the employment of similar postures and paraphernalia by the natives of modern Africa. He questioned whether the priest-physicians of the Nile Valley advanced far beyond the stage of primitive practise in dentistry, general surgery, and therapeutics; and was also skeptical as to their contributions to pharmacology. Before the Eighteenth Dynasty abscesses were incised and fatty tumors removed, but surgery of the extremities is doubtful. During the Fifth Dynasty splints were used with the idea of supporting the injured limb rather than of controlling the fragments.

The paper on "Peter of Abano: A Medieval Scientist," 1250–1316(?), by the present writer discussed the sources for and chief events of his life, showing that he perhaps lived beyond 1316 and taught at Treviso and Montpellier as well as at Paris and Padua, that the evidence for his being protected and employed by popes is better than that for his supposed trial by the inquisition, and that he was a commentator on Aristotle, a critical translator especially from the Greek, and an experimental astronomer, as well as a keen student of medicine and natural science. He was far, however, from being free from the superstition of his age.

Louis C. Karpinski, professor of mathematics in the University of Michigan, spoke concerning "The history of algebra." After touching briefly upon the contribution to mathematical speculation made by the Egyptians, he illustrated the relations of Greek geometry, especially in such a problem as that of the construction of a regular pentagon, to the development of algebraic thinking. He concluded with a summary of the contributions made by several Arabian mathematicians to the growth of algebra.

Henry Crew, professor of physics in Northwestern University, discussing "The problem of the history of science in the college curriculum," pled for a more human treatment

of the sciences and argued that the teaching of science might be made more stimulating to young minds by some treatment in each case of the personality and achievement of the man who had discovered the scientific fact or law in question. He further advocated separate courses in the history of science in the four fundamental fields of physics and chemistry, zoology and botany. He also raised the question of the age and academic position of the men to offer such courses.

The discussion was opened by Dr. Harry E. Barnes, of The New School for Social Research, who noted that of the four papers on the program only one was by a professor of history and expressed regret that of all the workers in the history of science probably even less than this twenty-five per cent. were professed historians. He emphasized the high value and promise of the history of science compared to the old political history, and sketched the progress particularly of American historiography of science. He also mentioned the increased space given to the history of science in the new Syllabus of Professor James Harvey Robinson's well-known course in the Intellectual History of Europe.

Charles H. Haskins, dean of the graduate school of Harvard University, who was chosen at this meeting second vice-president of the American Historical Association, expressed his sense of the importance of the history of science and desire that a conference in the subject might become a permanent feature of the program. In speaking of Professor Henderson's course at Harvard in the history of science, he suggested the advisability of requiring one laboratory course as a prerequisite to the course in the history of science, so that the students would not consider the history of science as a substitute for science itself.

Dr. Walter Libby, of the University of Pittsburgh, after a brief tribute to the memory of Sir William Osler as a friend of the history of science, advised that courses should be given for freshmen in the general history of science, and saw large possibilities for advanced work in this new field of university research. As for the less easy problem of the intermediate courses, he suggested the treatment of the history of physics, chemistry, and the like by experts in those subjects with the possible cooperation of the professor of the history of science. A treatment of various epochs by the department of general history with emphasis on the relation of scientific progress to the advance of civilization was also to bè desired. He alluded to the course in the history of science and civilization now required of freshmen in the combined arts and medical course at the University of Toronto, and to courses offered in the histories of medicine, pharmacy, and psychology at Pittsburgh.

In view of the good attendance at this conference, although it was not arranged for until almost the last moment, and the fact that the program was a little too crowded, I am inclined to suggest that another time there should be at least two conferences planned, one for papers embodying historical research, and the other for a discussion of the teaching of the history of science.

Lynn Thorndike

Western Reserve University,
Cleveland, Ohio

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### FINANCIAL REPORT OF THE PERMANENT SECRETARY

L. O. HOWARD, PERMANENT SECRETARY, IN ACCOUNT WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

*Dr.*

| | | |
|---|---|---|
| To balance from last account ........ | | $7,575.45 |
| To receipts from members: | | |
| Annual dues previous to 1918 ........ | $435.00 | |
| Annual dues 1918 ........ | 479.00 | |
| Annual dues 1919 ........ | 31,330.00 | |
| Admission fees .......... | 535.00 | |
| Life membership fees .... | 500.00 | 33,279.00 |
| To other receipts: | | |
| Sale of publications ...... | $22.50 | |
| Interest on accounts at bank ........ | 114.35 | |
| Miscellaneous receipts, including treasurer's pay- | | |

| | | |
|---|---|---|
| ment of SCIENCE subscriptions for life members, foreign postage, sale of programs, etc....... | 901.96 | 1,038.81 |
| | | $41,893.26 |

*Cr.*

| | | |
|---|---|---|
| By publications: | | |
| Publishers SCIENCE ............... | | $22,108.85 |
| By expenses, Baltimore meeting: | | |
| Sectional secretaries' commutations, accounts, carpenter, preliminary announcements, badges, programs, press secretary, local secretary, etc. | | 1,822.50 |
| By expenses, Pacific Division......... | | 1,500.00 |
| By expenses, Washington office: | | |
| Salary, Permanent Sec'y.. | $1,500.00 | |
| Salary, Assistant Sec'y .. | 2,100.00 | |
| Extra clerical help ....... | 2,356.25 | |
| Postage ................ | 1,391.07 | |
| Office supplies ........... | 115.88 | |
| Stationery and forms ..... | 1,564.45 | |
| Express, telegrams and telephone ............... | 139.96 | 9,167.61 |
| By miscellaneous expenses: | | |
| To treasurer, life membership fees .............. | $1,250.00 | |
| To refund of overpaid dues. | 7.00 | |
| To unredeemed bad check of member ........... | 3.00 | |
| To exchange charges by Amer. National Bank... | 2.52 | |
| To auditor, Committee of One Hundred on Scientific Research and Committee grants .......... | 42.88 | 1,305.40 |
| | | $35,904.36 |
| By balance to new account .......... | | 5,988.90 |
| | | $41,893.26 |

The foregoing account has been examined and found correct, the expenditures being supported by proper vouchers. The balance of $5,988.90 is with the following Washington, D. C., banks:

| | |
|---|---|
| American Nat. Bank of Washington... | $405.38 |
| Ditto (Savings Department) ........ | 3,205.59 |
| American Security and Trust Co...... | 2,377.93 |
| | $5,988.90 |

HERBERT A. GILL,
*Auditor*

WASHINGTON, D. C.,
December 20, 1919

## REPORT OF THE TREASURER

### BALANCE SHEET

*Assets*

| | |
|---|---|
| Investments: | |
| Securities (Exhibit "A")........ | $114.766.75 |
| Cash in banks .................... | 3,657.69 |
| | $118,424.44 |

*Liabilities*

| | |
|---|---|
| Funds: | |
| Life Memberships 343 at $50 ...... | $17,150.00 |
| Jane M. Smith Fund ............ | 5,000.00 |
| Colburn Fund ................... | 77,755.74 |
| Miscellaneous Funds ............ | 14,861.01 |
| | 114,766.75 |
| Uninvested Interest .............. | 3,657.69 |
| | $118,424.44 |

### CASH STATEMENT

*Receipts*

| | | | |
|---|---|---|---|
| 1918 | | | |
| Dec. 16. | Balance from last report .. | | $3,827.95 |
| | Interest from securities ....... | $5,447.18 | |
| | Interest from bank balance ....... | 52.94 | |
| | 25 Life Commutations ......... | 1,250.00 | 6,750.12 |
| | | | $10,578.07 |

*Disbursements*

| | | |
|---|---|---|
| *Investments* | | |
| $2,000 U. S. Victory Loan Bonds... | | $1,989.25 |
| *Grants* | | |
| W. P. Whiting .......... | $200.00 | |
| Myra M. Hulst .......... | 200.00 | |
| R. L. Moodie ............ | 200.00 | |
| A. L. Foley ............. | 150.00 | |
| Orin Tugman ............ | 100.00 | |
| E. M. Terry ............. | 150.00 | |
| F. C. Blake .............. | 100.00 | |
| E. B. Frost .............. | 500.00 | |
| Donald Reddick .......... | 500.00 | |
| S. D. Towney ............ | 250.00 | |
| C. H. Eigenmann ......... | 500.00 | |
| A. Hrdlička ............. | 200.00 | |
| G. L. Wendt ............ | 350.00 | |
| S. A. Courtis ............ | 100.00 | |
| Gilbert M. Smith ........ | 100.00 | |
| L. B. Arey .............. | 400.00 | 4,000.00 |

| | | |
|---|---|---|
| *Interest on Life Memberships* | | |
| 343 members ($17,150 at 4 per cent.) for 1918... | 686.00 | |
| 4 members (Jane M. Smith Fund) ................ | 200.00 | 886.00 |
| *Accrued Interest* on purchase of $2,000 Victory Loan Bonds ............. | | 45.13 |
| | | $6,920.38 |
| *Cash in Banks* | | |
| Fifth Avenue Bank of New York .................. | $1,499.49 | |
| U. S. Trust Company of New York ............. | 2,158.20 | 3,657.69 |
| | | $10,578.07 |

(Exhibit "A")

SCHEDULE OF SECURITIES

*Securities Purchased*

| Par Value | Purchase Value | |
|---|---|---|
| $10,000 Chicago and Northwestern Railway Co. general mortgage 4 per cent. bonds, due 1987 ........ | $9,425.00 | |
| $10,000 Atchison, Topeka and Santa Fe Railway Co. general mortgage 4 per cent. bonds, due 1995..... | 9,287.50 | |
| $10,000 Great Northern Railway Co. first and refunding mortgage 4.25 per cent. bonds, due 1961.... | 10,050.00 | |
| $10,000 Pennsylvania Railroad Co. consolidated mortgage 4.5 per cent. bonds, due 1960 ........ | 10,487.50 | |
| $10,000 Chicago, Burlington and Quincy Railroad Co. general mortgage 4 per cent. bonds due 1918. | 9,350.00 | |
| $10,000 Union Pacific Railroad Co. first lien and refunding mortgage 4 per cent. bonds, due 2008..... | 9,012.50 | |
| $10,000 Northern Pacific Railway Co prior lien railway and land grant 4 per cent. bonds, due 1997. | 9,187.50 | |
| $10,000 New York Central and Hudson River Rail-Co. 3.5 per cent. bonds, due 1997 .............. | 8,237.50 | |
| $8,000 U. S. Second Liberty Loan Bonds ........... | 8,000.00 | |
| $2,000 U. S. Third Liberty Loan Bonds ............ | 2,000.00 | |
| $2,000 U. S. Fourth Liberty Loan Bonds ............ | 2,000.00 | |
| $2,000 U. S. Victory Liberty Loan Bonds ............ | 1,989.25 | $89,026.75 |

*Bonds from Colburn Estate*

| Par Value | Appraised Value | |
|---|---|---|
| $20,000 Acker, Merrill and Condit Co. debenture 6 per cent. bonds ........ | $13,600.00 | |
| $7,000 Buffalo City Gas Co. first mortgage 5 per cent. bonds .................. | 1,540.00 | |
| $8,000 Park and Tilford Co. sinking fund debenture 6 per cent. bonds ......... | 6,400.00 | |
| $42,000 Pittsburgh, Shawmut and Northern Railway first mortgage 4 per cent. bonds, due February 1, 1952 ................ | 4,200.00 | $25,740.00 |
| $171,000 | | $114,766.75 |

I certify that I have audited the accounts of the Treasurer of the American Association for the Advancement of Science for the period December 16, 1918, to December 20, 1919; that the securities representing the investments of the association have been exhibited and verified; and that the income therefrom has been duly accounted for.

The financial statements accompanying the Treasurer's report are in accord with the books of the association and correctly summarize the accounts thereof.

HERBERT A. GILL,
*Auditor*

Dated December 20, 1919.

SCIENCE

**A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science**

**Published every Friday by**

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter